

## CLAIMS

We claim:

1. A process for slurry polymerization and for separating hydrocarbon fluid from solid polymer particles and purge gas, said process comprising:

polymerizing in a reaction zone at least one olefin monomer to produce a slurry comprising solid polymer particles and hydrocarbon fluid;

withdrawing a portion of the slurry from the reaction zone;

separating at least a majority of the hydrocarbon fluid from the solid polymer particles in an intermediate pressure zone as a vaporized hydrocarbon fluid stream;

condensing the vaporized hydrocarbon fluid stream in a condensing zone, whereby a condensed hydrocarbon fluid stream is formed;

transferring the solid polymer particles from the intermediate pressure zone to a purge zone in which a purge gas is passed through the solid polymer particles to remove entrained hydrocarbon fluid, thereby forming a mixed stream containing hydrocarbon vapor and purge gas;

transferring the mixed stream to a recovery zone where the purge gas and hydrocarbon fluid are separated to form a recovered purge gas stream and a recovered hydrocarbon fluid stream;

passing at least a portion of the recovered purge gas stream from the recovery zone to the purge zone; and

passing a portion of the recovered purge gas stream from the recovery zone to an extrusion feed zone.

2. The process of claim 1, wherein a portion of the recovered purge gas stream is passed to a closed loop transfer zone.

3. The process of claim 1, further comprising feeding fresh purge gas to the extrusion feed zone and refraining from feeding fresh purge gas to the purge zone.

4. The process of claim 1, further comprising transferring the condensed hydrocarbon fluid stream from the condensing zone to a recycle zone, and transferring at least a majority of the hydrocarbon liquid in the recycle zone to the reaction zone without fractionating the hydrocarbon liquid.
5. The process of claim 4, further comprising passing at least a portion of the recovered hydrocarbon fluid stream from the recovery zone to the recycle zone.
6. The process of claim 1, further comprising transferring vapor from the recycle zone to a fractionation zone.
7. The process of claim 1, further comprising transferring substantially no liquid from the recycle zone to the fractionation zone.
8. The process of claim 7, further comprising transferring a minor portion of liquid hydrocarbon from the fractionation zone to a catalyst preparation zone, and transferring a major portion of the liquid hydrocarbon from the fractionation zone to the recycle zone.
9. The process of claim 1, wherein the recovered purge gas stream from the recovery zone is not flared.
10. The process of claim 1, wherein the recovered purge gas stream exiting the recovery zone contains less than 5000 ppm of hydrocarbon.
11. The process of claim 1, wherein the recovered purge gas stream exiting the recovery zone contains less than 1000 ppm of hydrocarbon.
12. The process of claim 1, wherein the recovered purge gas stream exiting the recovery zone contains less than 500 ppm of hydrocarbon.

13. The process of claim 1, wherein the recovered purge gas stream exiting the recovery zone is essentially free of hydrocarbon.

14. The process of claim 1, wherein the purge gas is nitrogen and the hydrocarbon fluid comprises a diluent.

15. An apparatus for slurry polymerization in a hydrocarbon fluid and for separating hydrocarbon fluid from solid polymer particles and purge gas, the apparatus comprising:

(a) a polymerization reactor in which one or more olefins are polymerized to form solid polymer particles in a hydrocarbon fluid;

(b) an intermediate pressure chamber adapted for the separation of hydrocarbon fluid from the solid polymer particles, the chamber having an inlet for receiving hydrocarbon fluid and solid polymer particles from the polymerization reactor, a polymer outlet for discharging solid polymer particles, and a gas outlet for discharging vaporized hydrocarbon fluid;

(c) a condenser fluidly connected to the gas outlet of the intermediate pressure chamber, said condenser being adapted for condensing the vaporized hydrocarbon fluid by heat exchange and without compression;

(d) a purge column fluidly connected to the polymer outlet of the intermediate pressure chamber, said purge column adapted for receiving the solid polymer particles from the intermediate pressure chamber;

(e) a hydrocarbon/purge gas recovery unit adapted for the separation of hydrocarbon fluid from purge gas, and said recovery unit is fluidly connected to a top portion of the purge column and receives a fluid stream comprising purge gas and hydrocarbon fluid from the purge column;

(f) a recycle tank adapted to receive hydrocarbon liquid from the condenser, and the recycle tank is fluidly connected to the reactor; and

(g) an extruder feed tank connected to the purge column, said extruder feed tank receiving solid polymer from the purge column and receiving a portion of the purge gas stream exiting the recovery unit.

16. The apparatus of claim 15, further comprising a fresh purge gas feed connected to the extruder feed tank.

17. The apparatus of claim 15, wherein the recycle tank is also fluidly connected to receive a second hydrocarbon fluid stream from the hydrocarbon/purge gas recovery unit.

18. The apparatus of claim 15, further comprising a vapor delivery conduit attached to a top portion of the recycle tank, and fluidly connected to a first fractionation column.

19. The apparatus of claim 18, further comprising a liquid delivery conduit attached to a bottom portion of the recycle tank, and fluidly connected to the polymerization reactor.

20. The apparatus of claim 15, wherein the first and second fractionation columns do not have sidedraws.

21. The apparatus of claim 20, further comprising a liquid delivery conduit from the second fractionation column to a catalyst preparation tank.

22. The apparatus of claim 20, further comprising a second fractionation column adapted to receive a top product from the first fractionation column.

23. The apparatus of claim 15, wherein the fluid connection between the recycle tank and the reactor does not include a fractionation column.

24. The apparatus of claim 15, wherein the recovery unit is not connected to a purge gas flare.

25. A process for slurry polymerization and for separating hydrocarbon fluid from solid polymer particles and purge gas, said process comprising:

polymerizing in a reaction zone at least one olefin monomer to produce a slurry comprising solid polymer particles and hydrocarbon fluid;

withdrawing a portion of the slurry from the reaction zone;

separating at least a majority of the hydrocarbon fluid from the solid polymer particles in an intermediate pressure zone as a vaporized hydrocarbon fluid stream;

condensing the vaporized hydrocarbon fluid stream in a condensing zone, whereby a condensed hydrocarbon fluid stream is formed;

transferring the condensed hydrocarbon fluid stream from the condensing zone to a recycle zone;

transferring the solid polymer particles from the intermediate pressure zone to a purge zone in which a purge gas is passed through the solid polymer particles to remove entrained hydrocarbon fluid, thereby forming a mixed stream containing hydrocarbon vapor and purge gas;

transferring the mixed stream to a recovery zone where the purge gas and hydrocarbon fluid are separated to form a recovered purge gas stream and a recovered hydrocarbon fluid stream;

passing at least a portion of the recovered purge gas stream from the recovery zone to the purge zone;

passing at least a portion of the recovered hydrocarbon fluid stream from the recovery zone to the recycle zone; and

transferring at least a majority of the hydrocarbon liquid in the recycle zone to the reaction zone without fractionating the hydrocarbon liquid.

26. The process of claim 25, further comprising transferring vapor from the recycle zone to a fractionation zone.

27. The process of claim 26, further comprising transferring substantially no liquid from the recycle zone to the fractionation zone.

28. The process of claim 27, further comprising transferring a minor portion of liquid hydrocarbon from the fractionation zone to a catalyst mud preparation zone, and transferring a major portion of the liquid hydrocarbon from the fractionation zone to the recycle zone.

29. The process of claim 25, wherein the recovered purge gas stream from the recovery zone is not flared.

30. The process of claim 25, wherein the recovered purge gas stream exiting the recovery zone contains less than 5000 ppm of hydrocarbon.

31. The process of claim 25, wherein the recovered purge gas stream exiting the recovery zone contains less than 1000 ppm of hydrocarbon.

32. The process of claim 25, wherein the recovered purge gas stream exiting the recovery zone contains less than 500 ppm of hydrocarbon.

33. The process of claim 25, wherein the recovered purge gas stream exiting the recovery zone is essentially free of hydrocarbon.

34. The process of claim 25, wherein the purge gas is nitrogen and the hydrocarbon fluid comprises a diluent.

35. The process of claim 25, wherein the recovered purge gas stream is at least partially used for providing a motive force to solid polymer particles which have already passed through the purge zone.

36. An apparatus for slurry polymerization in a hydrocarbon fluid and for separating hydrocarbon fluid from solid polymer particles and purge gas, the apparatus comprising:

- (a) a polymerization reactor in which one or more olefins are polymerized to form solid polymer particles in a hydrocarbon fluid;
- (b) an intermediate pressure chamber adapted for the separation of hydrocarbon fluid from the solid polymer particles, the chamber having an inlet for receiving hydrocarbon fluid and solid polymer particles from the polymerization reactor, a polymer outlet for discharging solid polymer particles, and a gas outlet for discharging vaporized hydrocarbon fluid;
- (c) a condenser fluidly connected to the gas outlet of the intermediate pressure chamber, said condenser being adapted for condensing the vaporized hydrocarbon fluid by heat exchange and without compression;
- (d) a purge column fluidly connected to the polymer outlet of the intermediate pressure chamber, said purge column adapted for receiving the solid polymer particles from the intermediate pressure chamber;
- (e) a hydrocarbon/purge gas recovery unit adapted for the separation of hydrocarbon fluid from purge gas, and said recovery unit is fluidly connected to a top portion of the purge column and receives a fluid stream comprising purge gas and hydrocarbon fluid from the purge column; and
- (f) a recycle tank adapted to receive hydrocarbon liquid from the condenser, and the recycle tank is fluidly connected to the reactor, and the recycle tank is also fluidly connected to receive a second hydrocarbon fluid stream from the hydrocarbon/purge gas recovery unit.

37. The apparatus of claim 36, further comprising a vapor delivery conduit attached to a top portion of the recycle tank, and fluidly connected to a first fractionation column.

38. The apparatus of claim 37, further comprising a liquid delivery conduit attached to a bottom portion of the recycle tank, and fluidly connected to the polymerization reactor.

39. The apparatus of claim 38, further comprising a second fractionation column adapted to receive a top product from the first fractionation column.

40. The apparatus of claim 39, further comprising a liquid delivery conduit from the second fractionation column to a catalyst preparation tank.

41. The apparatus of claim 39, wherein the first and second fractionation columns do not have sidedraws.

42. The apparatus of claim 36, wherein the fluid connection between the recycle tank and the reactor does not include a fractionation column.

43. The apparatus of claim 36, wherein the recovery unit is not connected to a purge gas flare.